Seedprop: Faster than Backprop, Unlimited Depth.

Seedpropagation by Ethan G Appleby.

Seedprop:
$v_t[0] = x_t$
$q_t[0] = \Psi(x_t, y_t)$
$\bar{v}_t[\ell-1] = [v_t[\ell-1]; V_\beta]$
$C_t^+[\ell] > 0$
$C_t^-[\ell] > 0$
$a_+ = +1$
$a_- = -1$
$I_t^+[\ell] = C_t^+[\ell] \odot (\mathbb{1}\bar{v}_t[\ell-1]^\top)$
$I_t^-[\ell] = C_t^-[\ell] \odot (\mathbb{1}\bar{v}_t[\ell-1]^\top)$
$\bar{W}_t[\ell] = g[\ell] \odot (C_t^+[\ell] - C_t^-[\ell]) \oslash (C_t^+[\ell] + C_t^-[\ell] + \varepsilon)$
$u_t[\ell] = \bar{W}_t[\ell]\bar{v}_t[\ell-1]$
$v_t[\ell] = \varphi(u_t[\ell])$
$q_t[\ell] = \Psi_l(q_t[\ell-1], v_t[\ell], u_t[\ell], y_t)$
$r_t[\ell] = q_t[\ell] \odot \varphi'(u_t[\ell])$
$O_t[\ell] = r_t[\ell]\bar{v}_t[\ell-1]^\top$
$P_t^+[\ell] = |I_t^+[\ell] \odot (\mathbb{1}\bar{v}_t[\ell-1]^\top)|$
$P_t^-[\ell] = |I_t^-[\ell] \odot (\mathbb{1}\bar{v}_t[\ell-1]^\top)|$
$E_{t+1}^+[\ell] = \rho^E E_t^+[\ell] + \Delta t P_t^+[\ell]$
$E_{t+1}^-[\ell] = \rho^E E_t^-[\ell] + \Delta t P_t^-[\ell]$
$F_t^+[\ell] = \mathcal{L}^E(E_t^+[\ell])$
$F_t^-[\ell] = \mathcal{L}^E(E_t^-[\ell])$
$F_t[\ell] = \frac{1}{2}(F_t^+[\ell] + F_t^-[\ell])$
$K_t[\ell] = \eta[\ell] \odot (1 + \kappa^g[\ell] \odot F_t[\ell])$
$\Gamma_t^+[\ell] = -\lambda^c[\ell] \odot \log(C_t^+[\ell]) - \kappa^h[\ell] \odot F_t^+[\ell]$
$\Gamma_t^-[\ell] = -\lambda^c[\ell] \odot \log(C_t^-[\ell]) - \kappa^h[\ell] \odot F_t^-[\ell]$
$C_{t+1}^+[\ell] = \mathrm{clip}_+(C_t^+[\ell] \odot \exp(\Gamma_t^+[\ell] + K_t[\ell] \odot O_t[\ell]))$
$C_{t+1}^-[\ell] = \mathrm{clip}_+(C_t^-[\ell] \odot \exp(\Gamma_t^-[\ell] - K_t[\ell] \odot O_t[\ell]))$
$Z_t^+[\ell] = \log(C_t^+[\ell])$
$Z_t^-[\ell] = \log(C_t^-[\ell])$
$Z_{t+1}^+[\ell] = Z_t^+[\ell] + \Gamma_t^+[\ell] + K_t[\ell] \odot O_t[\ell]$
$Z_{t+1}^-[\ell] = Z_t^-[\ell] + \Gamma_t^-[\ell] - K_t[\ell] \odot O_t[\ell]$
$S_t[\ell] = \frac{1}{2}\log(C_t^+[\ell] \oslash C_t^-[\ell])$
$H_t[\ell] = \frac{1}{2}\log(C_t^+[\ell] \odot C_t^-[\ell])$
$C_t^+[\ell] = \exp(H_t[\ell] + S_t[\ell])$
$C_t^-[\ell] = \exp(H_t[\ell] - S_t[\ell])$
$\bar{W}_t[\ell] = g[\ell] \odot \tanh(S_t[\ell])$
$S_{t+1}[\ell] = S_t[\ell] + \frac{1}{2}(\Gamma_t^+[\ell] - \Gamma_t^-[\ell]) + K_t[\ell] \odot O_t[\ell]$
$H_{t+1}[\ell] = H_t[\ell] + \frac{1}{2}(\Gamma_t^+[\ell] + \Gamma_t^-[\ell])$
$W_t[\ell] = \bar{W}_t[\ell][:,1{:}n]$
$b_t[\ell] = \bar{W}_t[\ell][:,n{+}1]V_\beta$
$\hat{y}_t = v_t[L]$
$\square_t = \mathcal{L}(\hat{y}_t, y_t)$
$\square_t = \{C_t^+[\ell], C_t^-[\ell], E_t^+[\ell], E_t^-[\ell], q_t[\ell], g[\ell], \eta[\ell], \kappa^g[\ell], \kappa^h[\ell], \lambda^c[\ell]\}_l$
$\square_{t+1} = \Phi(\square_t, x_t, y_t)$
$(v_t[\ell], q_t[\ell], \square_{t+1}[\ell]) = \Phi_l(v_t[\ell-1], q_t[\ell-1], \square_t[\ell], y_t)$
$\square_{t+1} = \Phi^L \circ \Phi^{L-1} \circ \cdots \circ \Phi^1(\square_t, x_t, y_t)$